Reference

291

Screening of yeasts and industrial medium optimization for bioethanol production

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Abstract

Ethanol is an important industrial chemical with emerging potential as a biofuel to replace vanishing fossil fuels. Our aim is to screen ethanol-tolerant yeast (*Saccharomyces cerevisiae*) strains and develop fermentation media (based on industrial substrates/by-products) that enable to attain high fermentation rates and high ethanol titres at the end of the fermentation process, therefore minimizing distillation costs (which are considered a major constraint in industrial bioethanol production).

We have studied fermentation kinetics of different *S. cerevisiae* strains in a medium containing 300 – 350 g/L glucose with 100 g/L of corn steep liquor (CSL) as the sole nutrient source, using Erlenmeyer flasks fitted with glycerol-locks. Under this fermentation conditions, CEN.PK 113-7D (laboratory strain), CA11 and CA1162 (both isolated from "cachaça" production in Brazil), were able to produce 15.9 ± 0.4% (v/v), 16.4 ± 0.1% (v/v) and 17.1 ± 0.1% (v/v) ethanol, respectively. However, a medium with such high CSL concentration (100 g/L) could compromise the economical viability of industrial fermentation processes. Thus, using factorial design approaches we intend to partially replace CSL with other cheap nutrient sources to optimize the ethanol productivity and reduce the medium costs. For this optimization process we are using a basic medium consisting of 300 g/Lglucose syrup and 15 g/L CSL. A screening of nine supplements including nitrogen sources and trace elements was initially performed with strain CEN.PK 113-7D. CSL, Urea, $MgSO_4$ and $CuSO_4$ were identified as the most significant supplements to yield a higher ethanol titre. After the optimization process, it was observed that the ethanol titres obtained from 325 g/L initial glucose has increased from 15.9 ± 0.4% (v/v) (supplementation with 100 g/L CSL) to 17.3 ± 0.2% (v/v) when supplemented with the critical concentrations of CSL, $MgSO_4$, Urea and $CuSO_4$provided by the model (significance level of 95%). A screening of vitamins, unsaturated fatty acids and ergosterol was conducted with the optimized medium and the results will be discussed.

Furthermore, different strains isolated from "cachaça" and bioethanol production facilities in Brazil, which demonstrated high ethanol productivity when grown in the original medium (100 g/L CSL), are being tested with the optimized medium for bioethanol production.